RESEARCH PAPER

Anti-diabetic and anti-inflammatory activity of *Ginger and Chamomile* formation mediated zinc oxide nanoparticles

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Abstract

Introduction: The flower of *Chamomile* has Amino acids, polysaccharides, fatty acids and some phytochemicals such apigenin 7-O-glucoside, luteolin, terpene compounds, chamazulene and *Zingiber officinale* which help to loosen and discharge phlegm has found to produce medicinal properties like anti-inflammatory, anti-oxidant, antiplatelet, anti-diabetic and anti-microbial action.

Aim: To Prepare Zinc oxide mediated nanoparticles of *Ginger and Chamomile* and to analyze its Anti-diabetic and Anti-inflammatory activity.

Materials and methods: 1 g *Matricaria chamomilla L.*(chamomile) and *Zingiber officinale* (ginger) powders mixed with 100 mL of distilled water were boiled. The final extract was then filtered. Spectrometry analysis was done. Positive correlation analysis level of significance was set as r=1.

Result: There was an increase in absorbance with increase in concentration (microlitre), showing there is a positive correlation (r=1) with rise in anti-diabetic and anti-inflammatory activity.

Conclusion: Through this study, it was possible to conclude that *Ginger and Chamomile* mediated zinc oxide nanoparticles exhibit better anti-diabetic and anti-inflammatory properties compared to commercial products in the pharmaceutical industry.

Keywords: Anti-inflammatory, Anti-diabetic, *Chamomile*, *Ginger,* Zinc oxide, Diabetes, Health

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Introduction

Diabetes is a chronic metabolic disease disorder due to hyperglycaemia and an inflammatory process which is interconnected and driven with complications like poor wound healing, cardiovascular disease and immune disorders[1]. As a result the therapies prioritizing the oxidative stress, blood sugar control and inflammation. Plant based compounds paired with nanotechnology have drawn interest to enhance both bioavailability and effectiveness [2].

Chamomile (*Matricaria chamomilla L.*), a medicinal plant from Asteraceae family, grown widely in Europe and Asia with biological benefits of existences in cosmetics, herbal remedies and drugs [3,4]. 120 active phytochemicals exist such as flavonoids, coumarins, terpenoids and phenolics [5]. Apigenin, chamazulene, α-bisabolol, luteolin, quercetin deliver as anti-inflammatory, antioxidant, antidiabetic and antimicrobial agents [6]. *Ginger*(*Zingiber officinale Roscoe*), from Zingiberaceae family originating from southeast asia, treating digestive tissues, metabolic conditions and inflammations [7]. Its rhizome holds gingerols, parasols, shogaols, zingerone as potent compounds with its driven effects [8]. Studies confirm ginger delivered antioxidant and anti-inflammatory activities [9]. In Type II diabetes patients Ginger boost the insulin response, reduces HbA1c and balance the lipids [10].

Nanotechnology plays a revolutionary role in biomedicine via nanoparticle drug carriers. Zinc oxide nanoparticle (ZnO NPs) was known for its biocompatible and large surface area which supports

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antidiabetic activity by improving the pancreatic cell function, insulin signalling thereby improving the metabolism of glucose and decrease in blood sugar level [11,12]. The ions suppress the production of cytokines like TNF-α, IL-1β and IL-6 thereby reducing the inflammatory response [13]. The ZnO nanoparticle along with the plant extract will result in enhanced biological activity through synergistic mechanism of both metal ions and phytochemicals also it improves the stability, drug delivery and bioavailability of bioactive compounds [14,15]. In recent years, green synthesis of nanoparticles using plant extracts has gained an ecofriendly and sustainable alternative to the conventional methods. This study aims to evaluate the extract of *Chamomile and Ginger* mediated ZnO nanoparticles and its anti-diabetic and anti-inflammatory activities.

Materials and methods

Research Location

This in vitro investigation into the anti-inflammatory and antidiabetic effects of zinc oxide nanoparticles synthesized using ginger and chamomile extracts took place at the Nano Research Laboratory of Saveetha Dental College and Hospital. Dried powders of chamomile and ginger were used to create the plant extracts, with the full protocol approved by the senior nano research supervisor.

Extract Preparation from Plants

We weighed 1 gram each of *Matricaria chamomilla L. (Chamomile) and Zingiber officinale (Ginger)* powders. Each was placed in a beaker containing 100 mL of distilled water (measureod via cylinder). The mixtures were then heated to a boil at 90°C for 15 minutes (Figure 1).

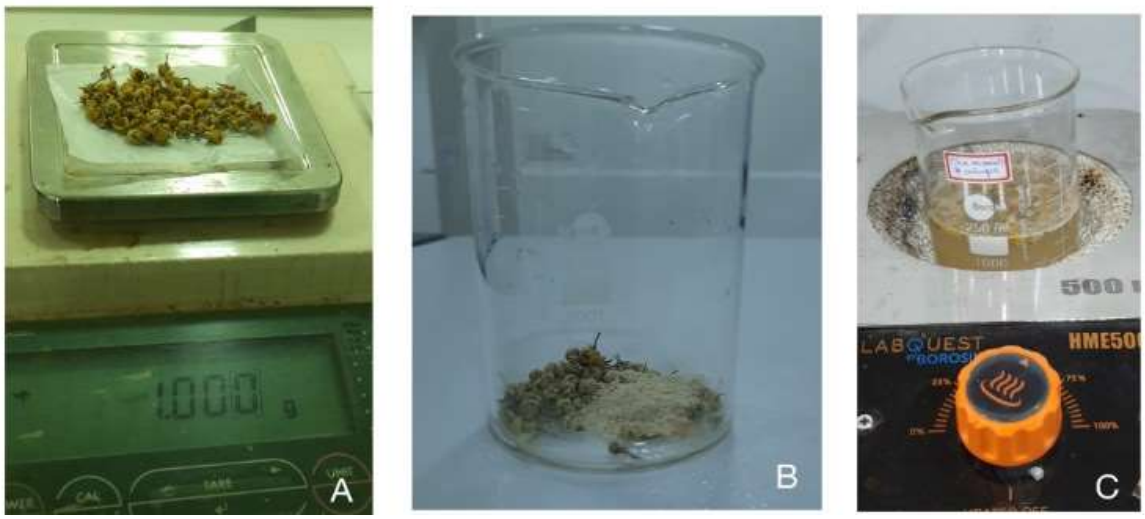

Figure 1: Depicts the preparation of plant extract. A. Weighing of *Chamomile* flowers B. Beaker with *Chamomile* and *Ginger* C. Boiling of *Chamomile* and *Ginger* extract.

Synthesis of Zinc Oxide Nanoparticles

A total of 0.594 g zinc oxide powder was measured and dissolved in 50 mL distilled water within a conical flask (Figure 2). The heated extracts were filtered into sterile beakers. We combined 50 mL of each plant extract with 50 mL zinc oxide solution and stirred magnetically overnight. Pure distilled water served as the control. Samples were spun in a centrifuge at 8000 rpm for 10 minutes (Figure 3).

Figure 2: Depicts the preparation of zinc oxide nanoparticles. A. Weighing of zinc oxide powder. B. Diluted zinc oxide.

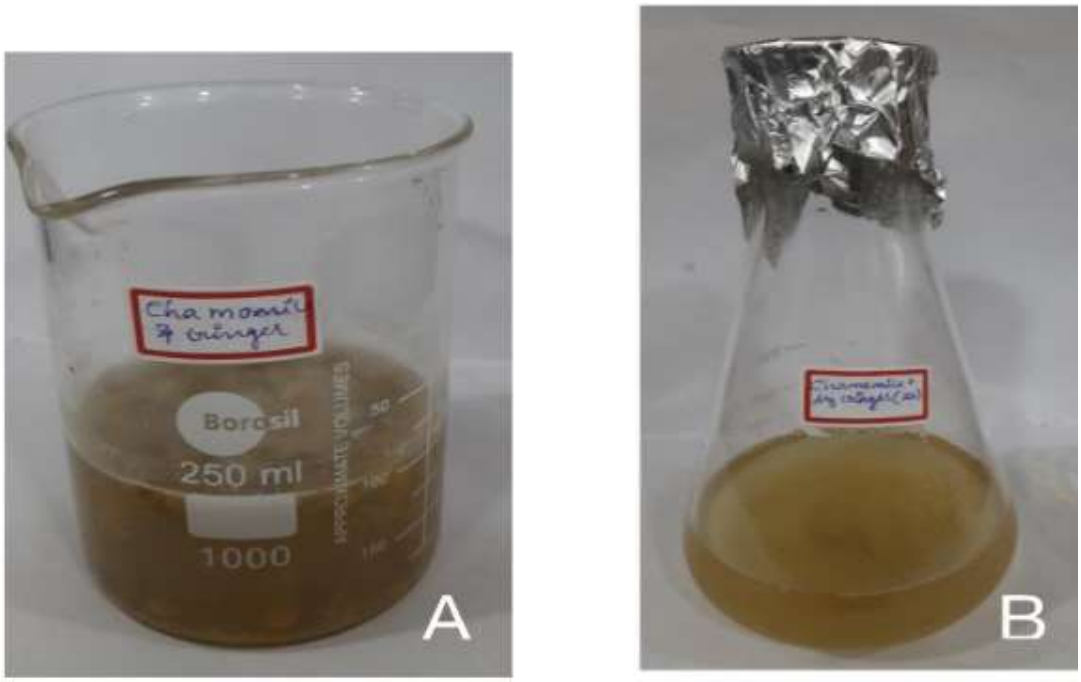

Figure 3: Depicts the preparation of *chamomile* and *ginger* mediated zinc oxide nanoparticles. A. Filtered *Chamomile* and *Ginger* extract. B. *Chamomile* and *Ginger* mediated zinc oxide nanoparticles.

Pellets from centrifugation were collected, dried in a hot air oven at 100°C for 24 hours, and diluted to concentrations of 10, 20, 30, 40, and 50 µL. Each included 0.45 mL bovine serum albumin, adjusted to pH 6.3 using 1N hydrochloric acid. Diclofenac sodium acted as the reference standard; mixtures were incubated at 55°C for 20 minutes prior to analysis.

Anti-inflammatory activity

The anti-inflammatory activity of *Ginger and Chamomile* was evaluated using a modified protocol based on the
method proposed by Selvapriya et al (2021) [16]. Various concentrations of *Ginger and Chamomile* extract (10 uL, 20 uL, 30 pl, 40 ul, and 50 uL) were added to 0.45 ml of 1% aqueous bovine serum albumin (BSA). The pH of the mixture was adjusted to 6.3 using a small amount of IN hydrochloric acid. The samples were incubated at room temperature for 20 minutes, followed by heating at 55°C in a water bath for 30 minutes. After cooling to room temperature, the absorbance of the samples was measured spectrophotometrically at 660 um. Diclofenac sodium was used as the standard, and dimethyl sulfoxide (DMSO) served as the control . Percentage of protein denaturation was determined utilizing the following equation,

% Inhibition=Absorbance of control-Absorbance of sample/Absorbance of control×100

Alpha-Amylase Inhibition Assay

Reagents and Materials were similar to the previous study by Thirukumaran et al (2021) 0.594 g zinc oxide Chamomile and ginger extracts at 10–50 µL concentrations, 50 µL α-amylase, 1000 µL starch, 500 µL sodium hydroxide (NaOH), 500 µL dinitrosalicylic acid (DNS), Acarbose (standard control), Phosphate buffer, Control Setup, Acarbose served as the positive control (set to a value of 1) for benchmarking [17].

Procedure for α-Amylase Inhibition

Reactions started by adding 490, 480, 470, 460, or 450 µL phosphate buffer to 10, 20, 30, 40, or 50 µL of Ginger- or Chamomile-mediated zinc oxide nanoparticles. Next, 50 µL α-amylase was introduced, followed by 1000 µL starch. Tubes incubated in a 100°C water bath for 5 minutes. Then, 500 µL NaOH was added, and the process finished with 500 µL DNS, followed by another 5-minute incubation in hot water. A shift from yellow to orange signaled inhibition.

For blanks, 30 µL extract was mixed with phosphate buffer, repeating all steps except α-amylase and starch additions. Solutions cooled at room temperature.

Data Handling

Results from different extract concentrations were compared to controls and organized into tables. Independent t-tests handled statistical analysis, with Spearman correlations run using IBM SPSS version 23.

Result

Anti-inflammatory activity

With an increase in concentration (microlitre) there is a positive correlation (r=1) with rise in anti-diabetic and anti-inflammatory activity. At 10µL concentration maximum absorbance was 25.7%, at 20µL concentration it was 28.82%, while at 30µL, 40µL, 50µL concentration absorbance were 31.46%, 34.02% and 37.76% respectively (Figure 4).

Figure 5 on anti-inflammatory activity depicts rise in concentration on different concentrations (10µl, 20µl, 30µl, 40µl, 50µL) in microlitre with absorbance at 660 nm. *Ginger* and *Chamomile* extract showed positive anti-inflammatory activity (r=1) with increase in concentration with absorbance.

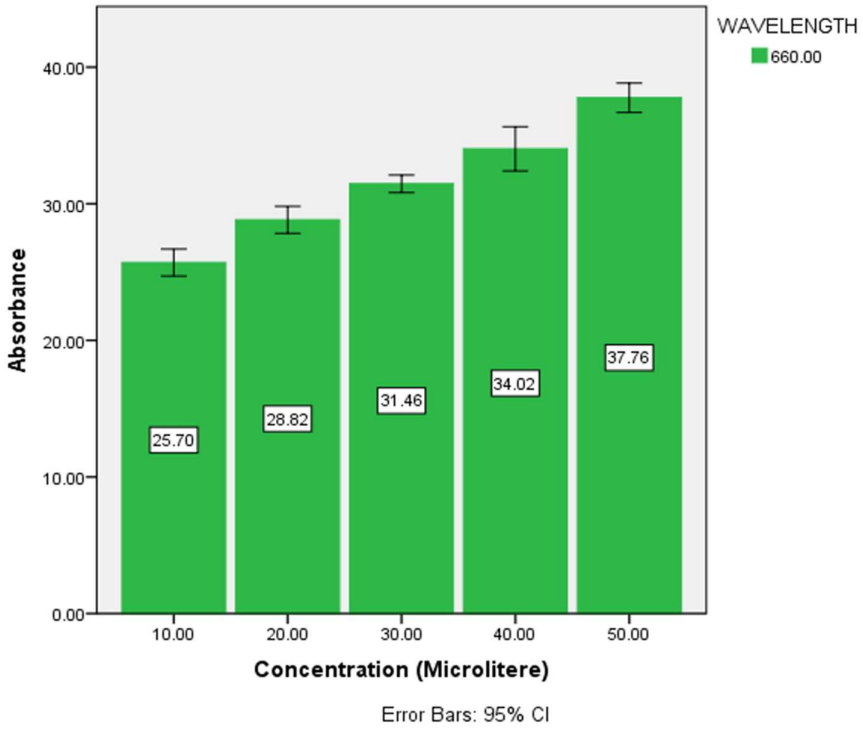

Figure 4: The bar graph depicts the correlation of *Ginger* and *Chamomile* with its anti-inflammatory activity. X-axis shows concentration in the microliter and Y-axis shows the absorbance. There was an increased activity with increase in concentration, showing its positive correlation.

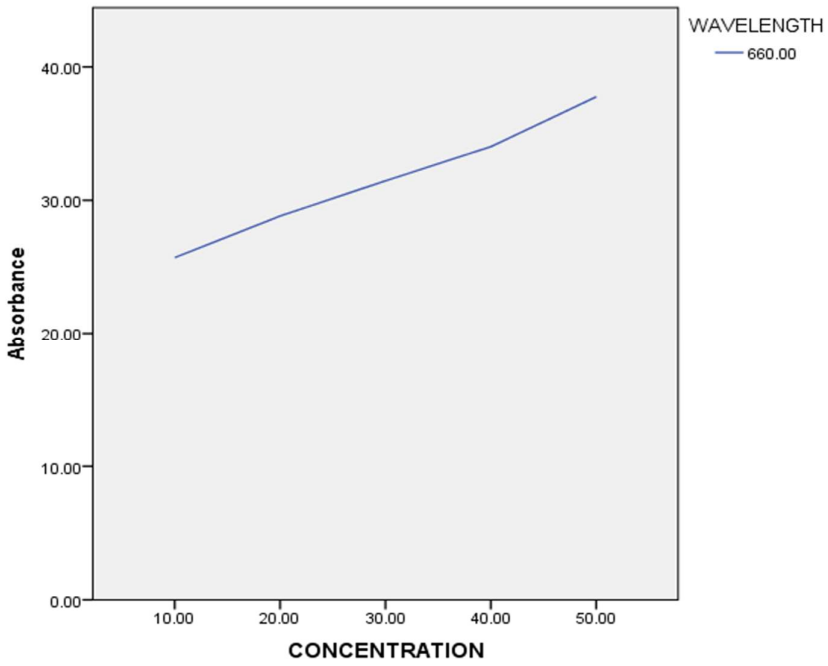

Figure 5: The line graph depicts the correlation of *Ginger* and *Chamomile* with increased concentration. X-axis shows concentration in the microliter and Y-axis shows the absorbance showing its positive correlation with raise in concentration.

Anti-diabetic activity

The antidiabetic activity of *Chamomile* and *Ginger* extract mediated ZnO nanoparticles was determined by Alpha amylase inhibition activity. The extract's activity was compared with the standard. The plant extract exhibits positive correlation with increase in concentration exhibiting its In vitro antidiabetic activity (Figure 3,4).

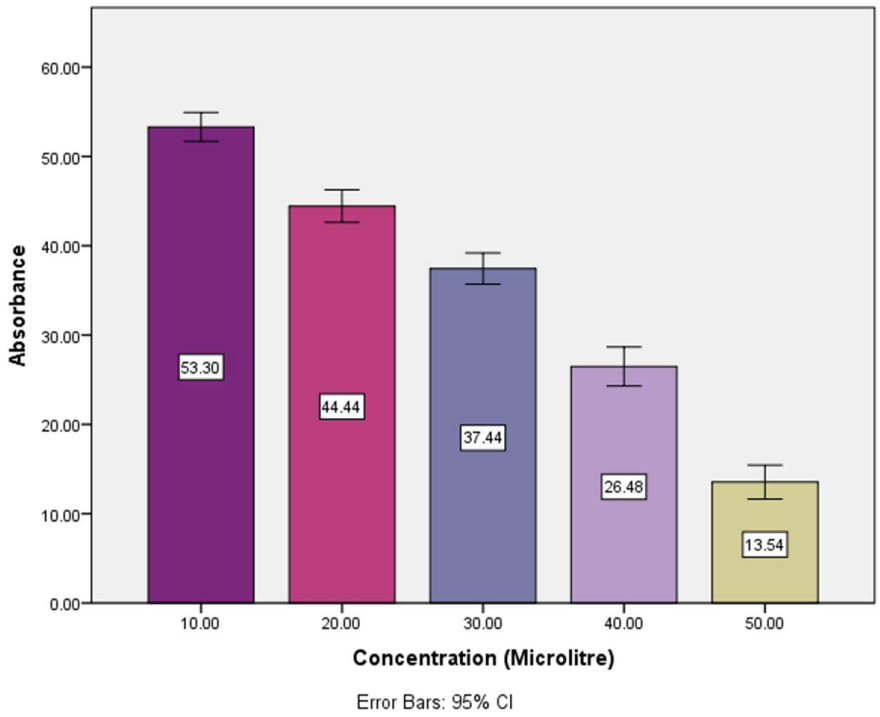

Figure 6: The bar graph depicts the correlation of *Ginger* and *Chamomile* with its anti-diabetic nanoparticle activity. X-axis shows concentration in the microliter and Y-axis shows the absorbance. There was an increased activity with increase in concentration, showing its positive correlation.

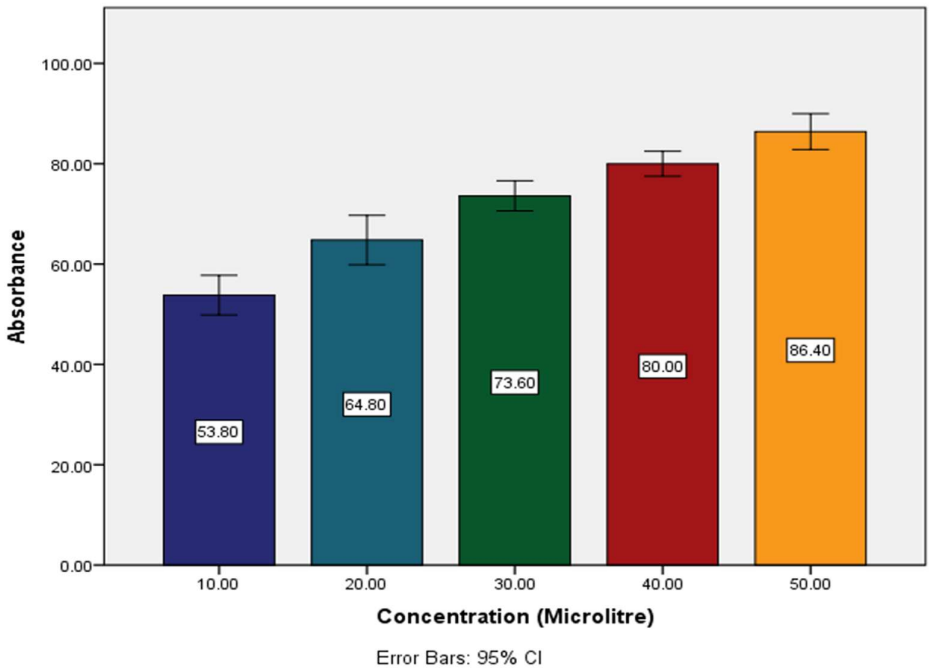

Figure 7: The bar graph depicts the correlation of *Ginger* and *Chamomile* with its anti-diabetic herbal activity. X-axis shows concentration in the microliter and Y-axis shows the absorbance. There was an increased activity with increase in concentration, showing its positive correlation.

Discussion

The results obtained from the study are, positive correlation of antidiabetic activity with increase in concentration. The *Chamomile*and *Ginger*along with ZnO nanoparticles exhibits promising anti diabetic activity as it has a better application in drug delivery because of its size which is less than 100nm. *Chamomile* flower extract shows anti-diabetic effect in the obese mice through transcriptional stimulation of nutrient sensors of the peroxisome proliferator activated receptor (PPAR) family [18]. The daily consumption of *Chamomile* tea with meals could contribute to the prevention of hyperglycaemia and other diabetic related complications. Intake of *Chamomile* has improved the glycemic control in the patients with type 2 diabetes mellitus [19].

According to the previous studies, *Ginger* exerts its anti-diabetic activity through restorative effects on the pancreatic B cells, as the cells have the ability in increasing the insulin sensitivity and the peripheral utilization of glucose [20]. *Ginger* acts as a natural safe herbal medication. It can be used to support the liver functions in the diabetic patients. *Ginger* powder supplements can improve the fasting blood sugar in the body [21]. Other studies prove that zinc oxide has a significant impact in decreasing blood glucose level [22].

Our study on anti-inflammatory activity of *Chamomile and Ginger* revealed positive correlation with increase in concentration. Inflammation is described as the body's defensive reaction that appears in a state of microbial invasion, antigen exposure, cell and tissue damage. Numerous cell type mediators, receptors, and signaling pathways are involved in complicated interactions. Chronic inflammation, in particular, plays a crucial influence in the pathophysiology of numerous diseases, including atherosclerosis, cancer, diabetes, rheumatoid arthritis, and aging. Studies have long demonstrated the anti-inflammatory properties of *Ginger* & *Chamomile*and its active ingredients. The activity of 6-, 8-, and 10-gingerols was linked to their inhibitory influence on COX-2 mRNA production and the corresponsive COX-2 enzyme [23]. Our study correlates with similiar anti-inflammatory effects of both *Ginger and Chamomile.* The anti-inflammatory properties of several *Chamomile* ingredients, including bisabolol and bisabolol oxide have been demonstrated to inhibit 5-lipoxygenase activity in tests conducted in cell culture. Rats skin irritation brought on by the application of xanthine-oxidase and cumene hydroperoxide was demonstrated to be reduced by apigenin 7-O-glucoside [24]. Which collectively resulted in its anti-inflammatory property. The UV spectrometry tested in various concentrations (10, 20, 30, 40 and 50 microliter) showed *Ginger* and *Chamomile extract* possessed potent anti-inflammatory properties, as the percentage of inhibition of anti-inflammatory activity increases with the addition of 10 µL of concentration each to the *Ginger* and *Chamomile* mediated zinc oxide nanoparticles extract. The present study reveals anti-inflammatory being correlated with increase in concentration.

From the previous studies referred, chamazulene, alpha-bisabolol, and apigenin of *Chamomile* have been found to possess the highest anti-inflammatory activity against pro-inflammatory agents. The effects of azulenes on the pituitary and adrenal glands, which result in increased cortisone release and decreased histamine production, with anti-inflammatory properties [25]. The anti-

inflammatory effect of *Ginger* extract were assessed at various doses in a carrageenan-induced rat paw edema model, and it was found to reduce the levels of the inflammatory mediators PGE2, TNF-α, IL-6, monocyte chemoattractant protein-1 (MCP-1), and myelo-peroxidase (MPO) by 32% to 60%. *Ginger* extract was found to have much more anti-inflammatory efficacy than diclofenac at the same concentration, and 6-SG was more effective than other shogaols [26]. However, it was discovered that the effects of 6-, 9-, and 10-shogaols of *Ginger* on COX-2 mRNA expression were less inhibitive as compared to standard drugs [27]. However this study is limited to only the anti-diabetic property of *Chamomile* and *Ginger* formation mediated zinc oxide nanoparticles. The study can be done on other different properties of *ginger* and *chamomile*. Further studies should be done to know the resistance and impact of *ginger* and *chamomile* on various diseases.

Conclusion

From the results obtained, it is concluded that the green synthesized *Chamomile and Ginger* mediated zinc oxide nanoparticles possess potent anti-diabetic and anti-inflammatory properties. The use of naturally obtained herbal products is becoming more popular in the modern period since they are more potent and have less side effects than synthetically produced drugs. With further research, *Chamomile and Ginger* mediated zinc oxide nanoparticles, a naturally synthesized medicine with a potent drug delivery system and fewer side effects, could be developed into a potent anti-inflammatory drug.

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Conflict of interest

The authors would like to declare no conflict of interest in the present study.

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